A Status Report on the Fermilab Holometer
(E990 at MP8)

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Fermilab All-Experimenters' Meeting
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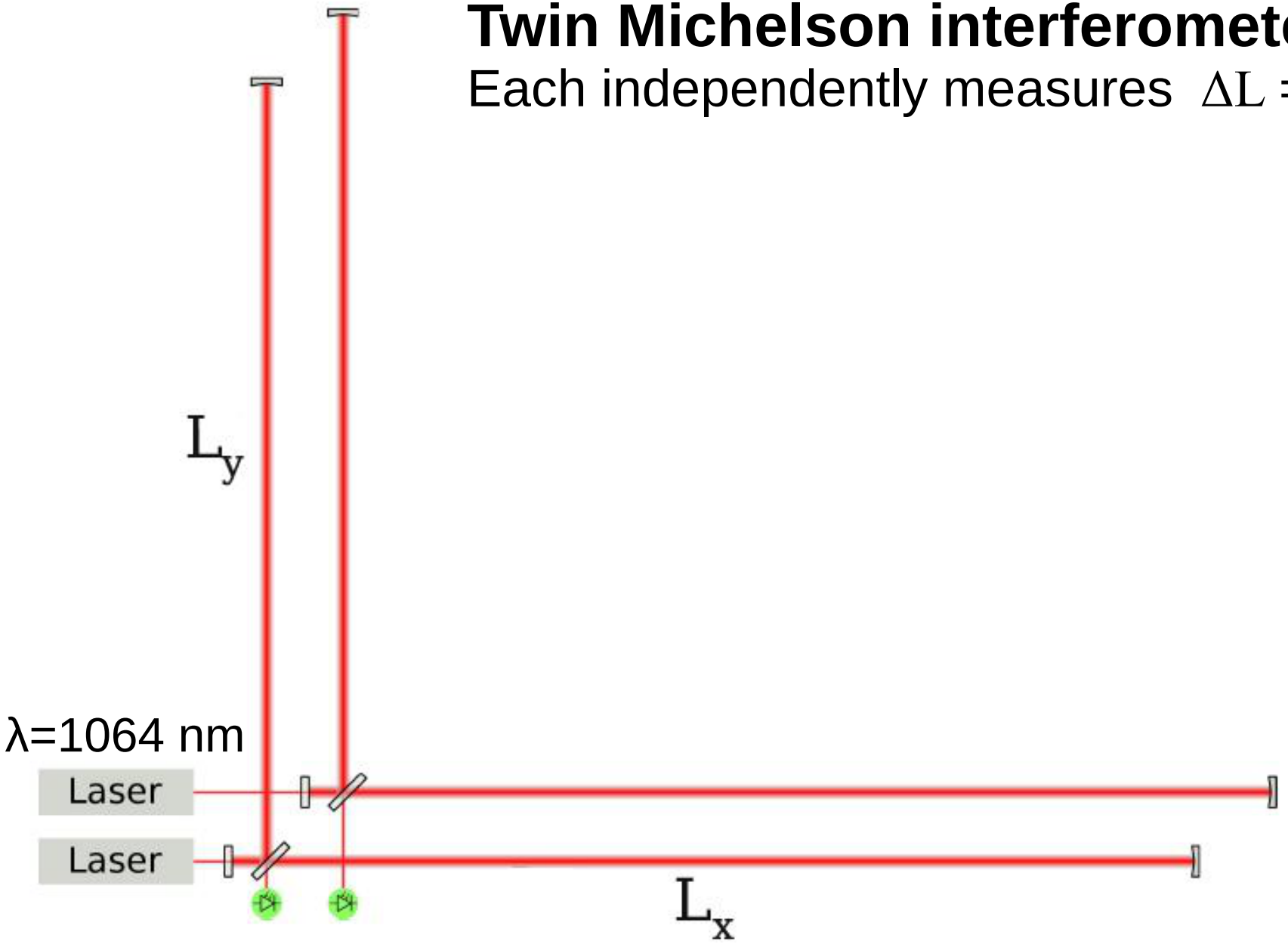
Experimental Overview

Twin Michelson interferometers

Each independently measures $\Delta L = L_x - L_y$



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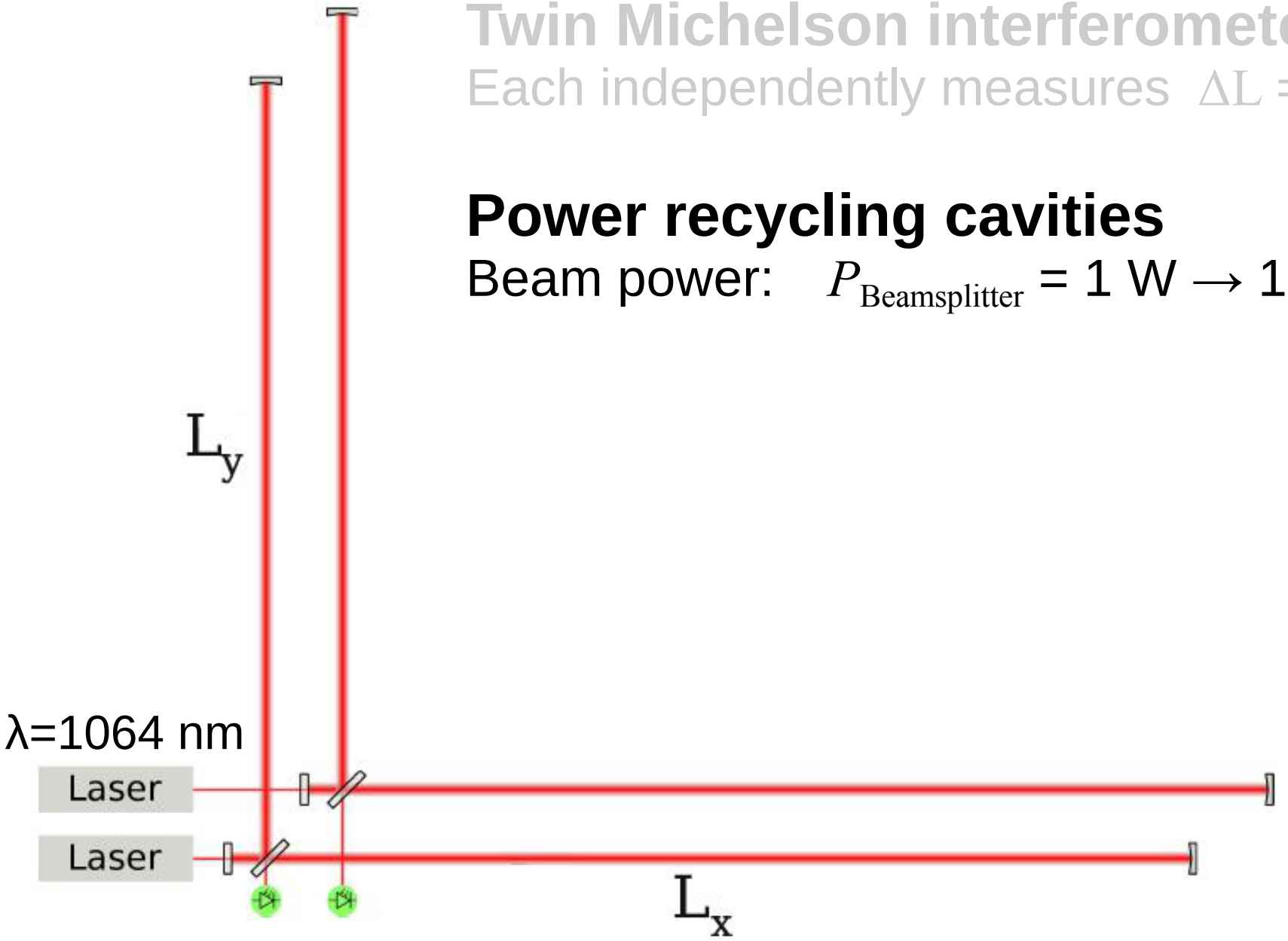
Power recycling cavities

Beam power: $P_{\text{Beamsplitter}}$ = 1 W → 1 kW



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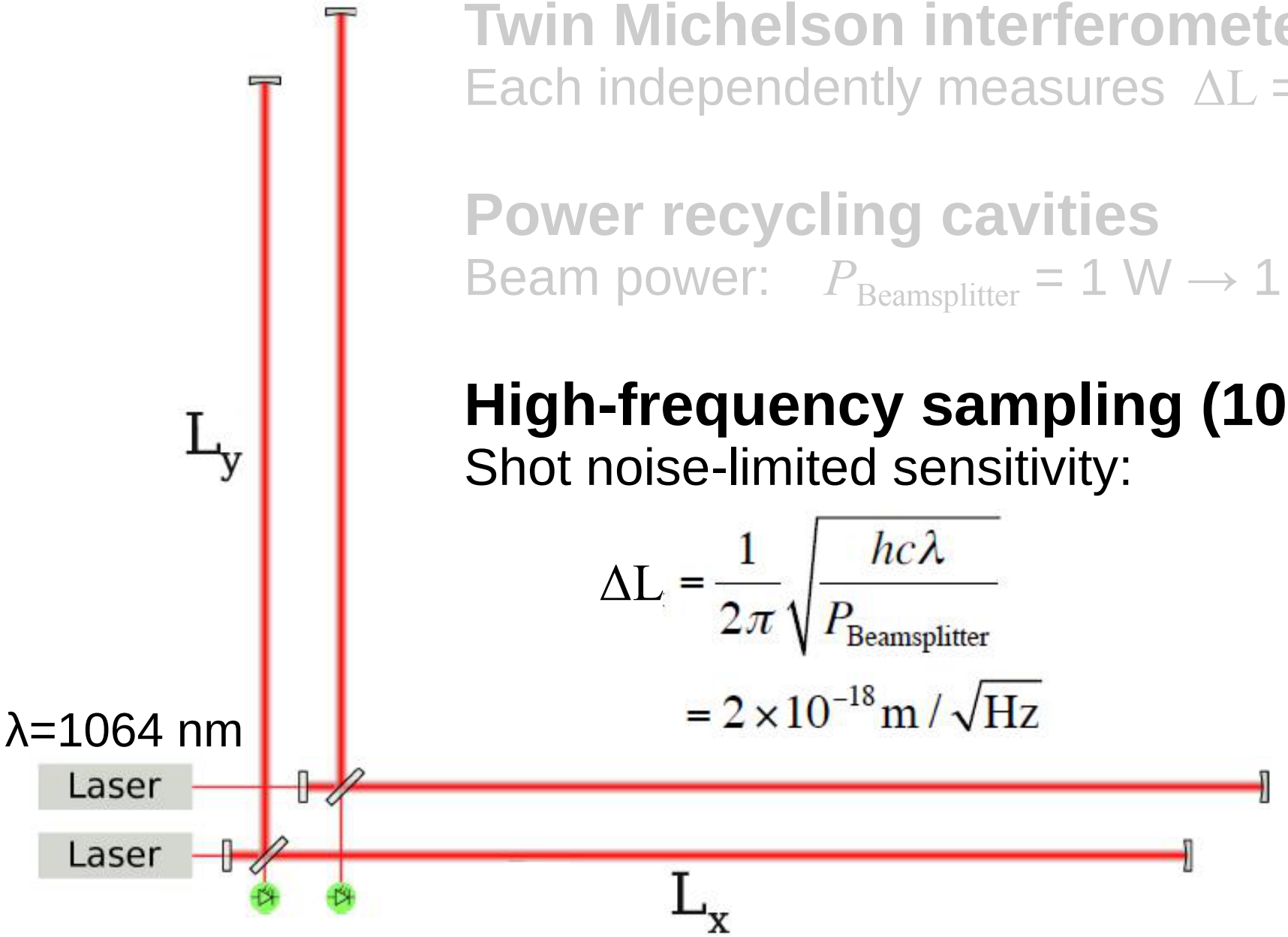

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High-frequency sampling (100 MHz)

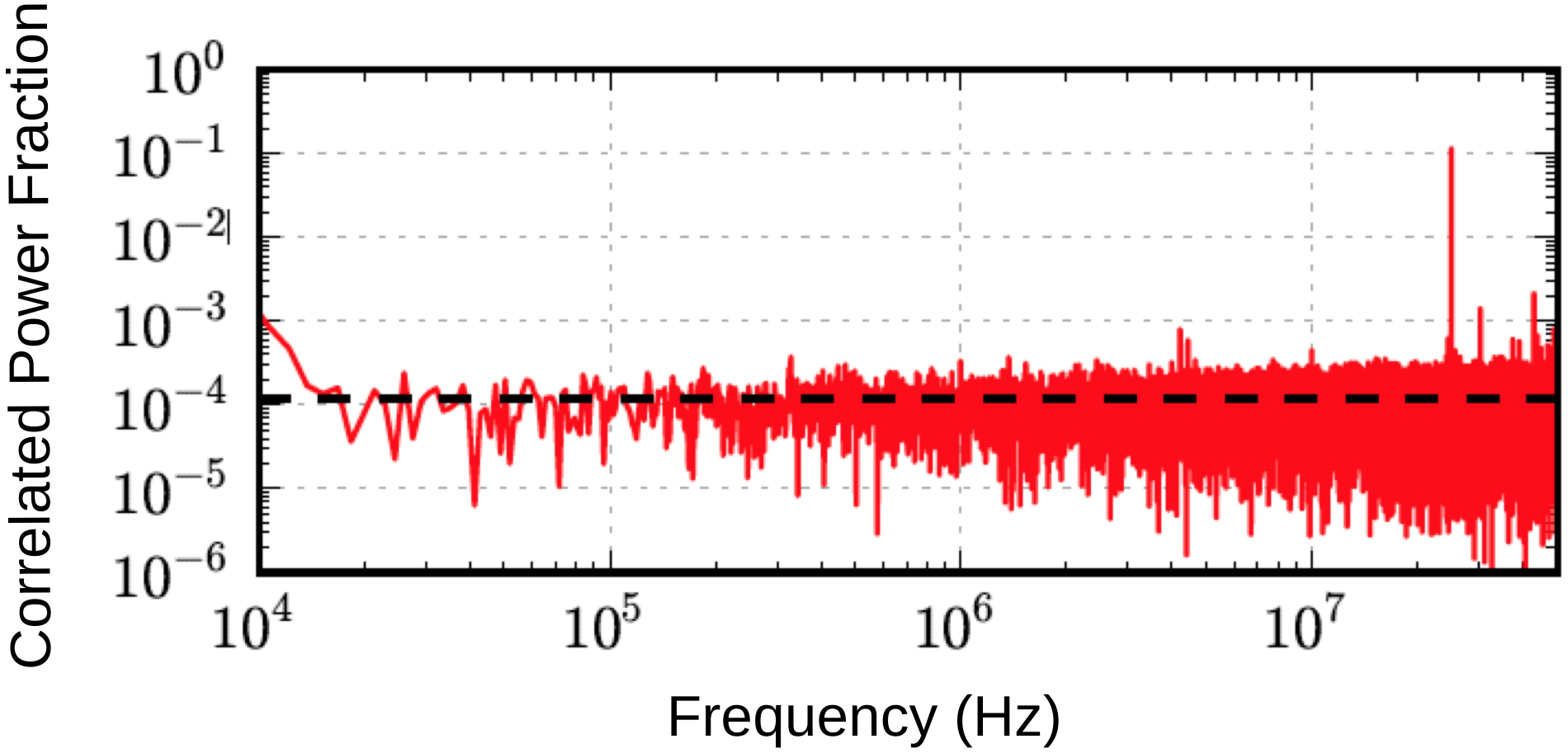
Shot noise-limited sensitivity:

$$\Delta L = \frac{1}{2\pi}\sqrt{\frac{hc\lambda}{P_{\text{Beamsplitter}}}}$$

$$= 2\times10^{-18}\,\text{m}/\sqrt{\text{Hz}}$$

Detector noise cross-correlation achieves design sensitivity

6.5 hours of data @ 1 ms/FFT
→ Average of 70,000,000 FFTs
→ 70 TB

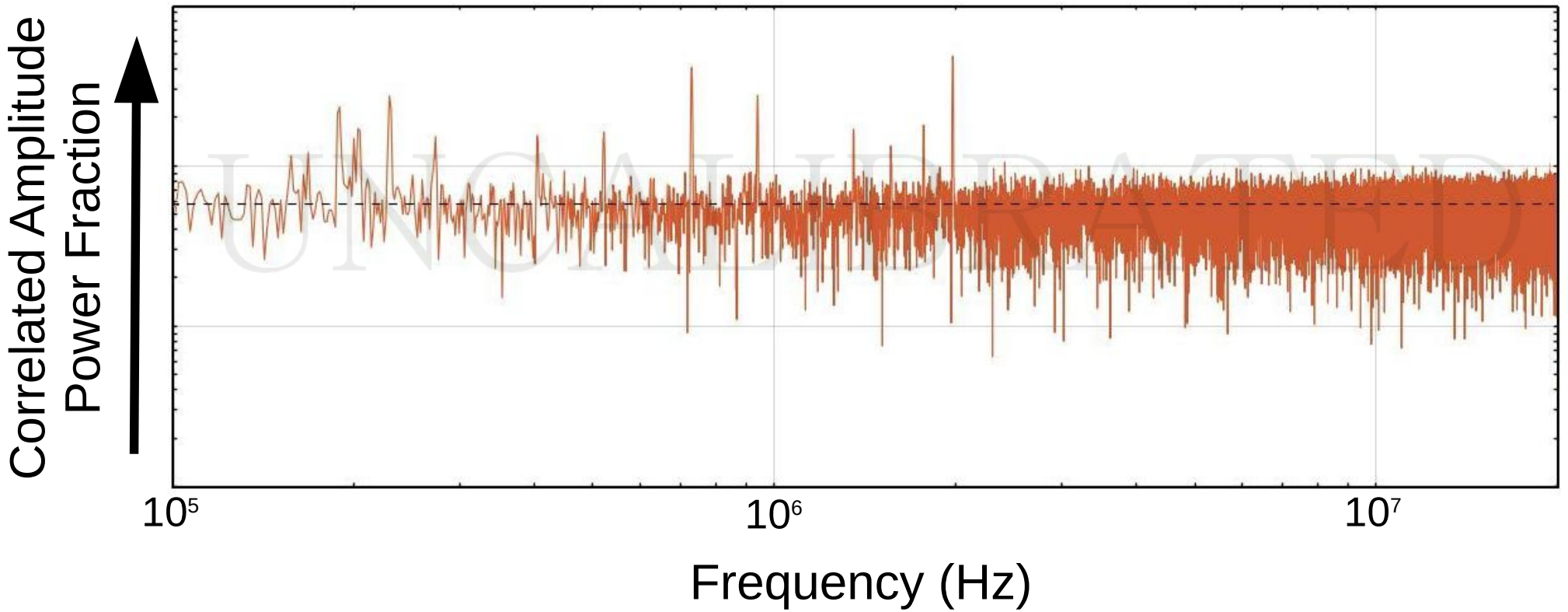


Two-Interferometer Cross-Correlation

Interferometer #1: 992 W

Interferometer #2: 865 W

Integration time: 30 s



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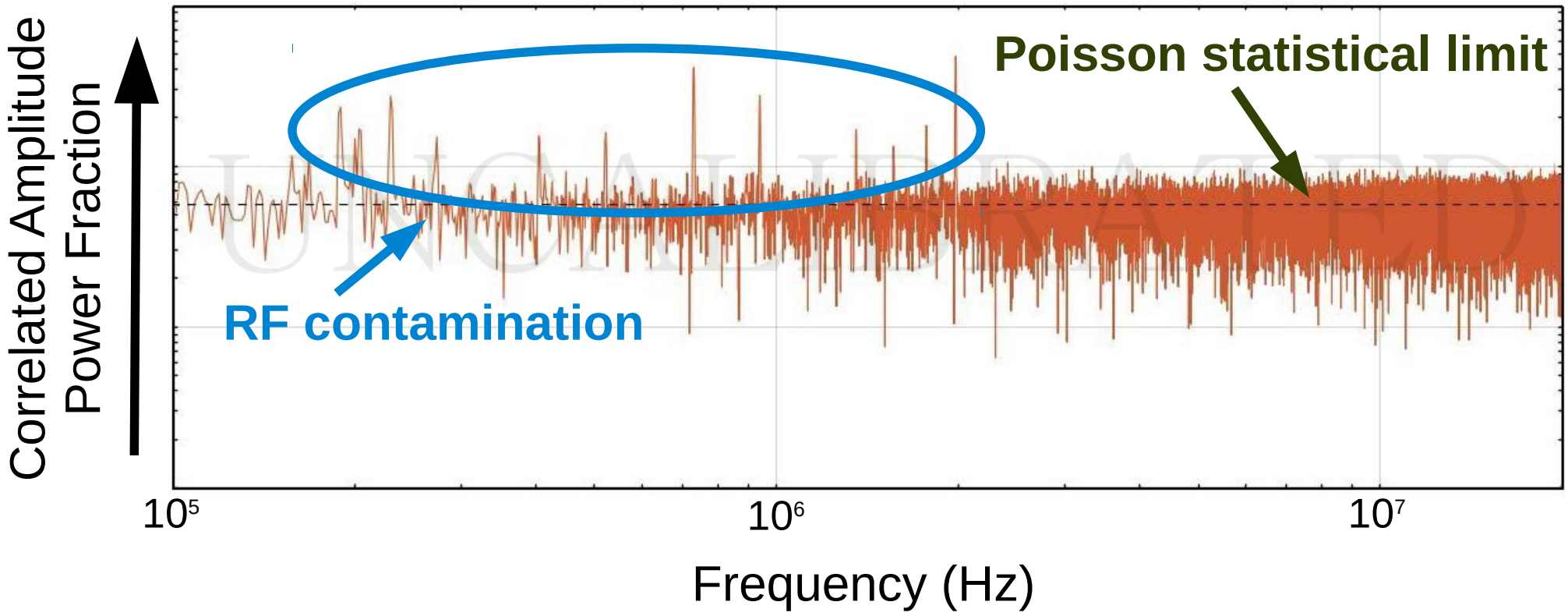


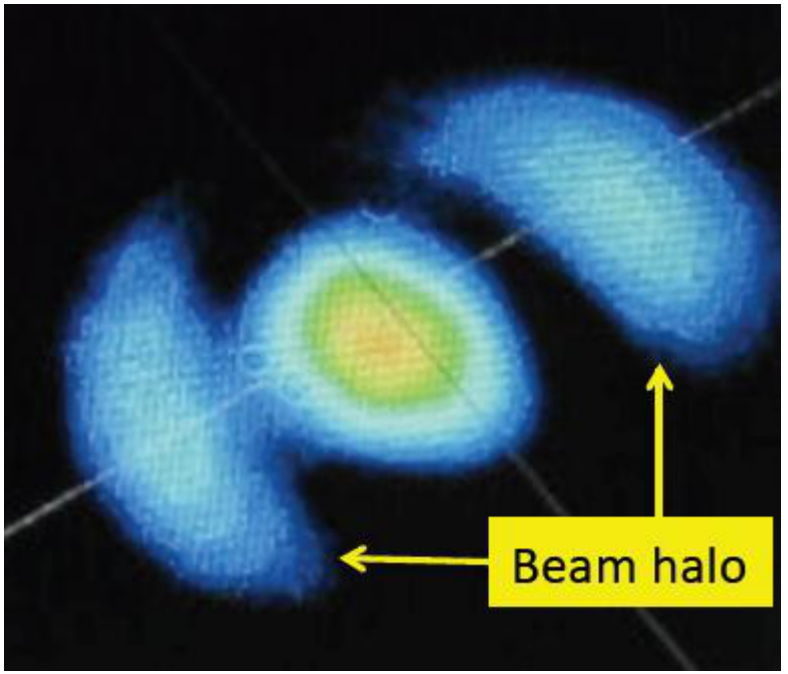
Contrast Defect

Astigmatism in optics is producing a halo of non-interfering “junk” light

~2/3 of total output power

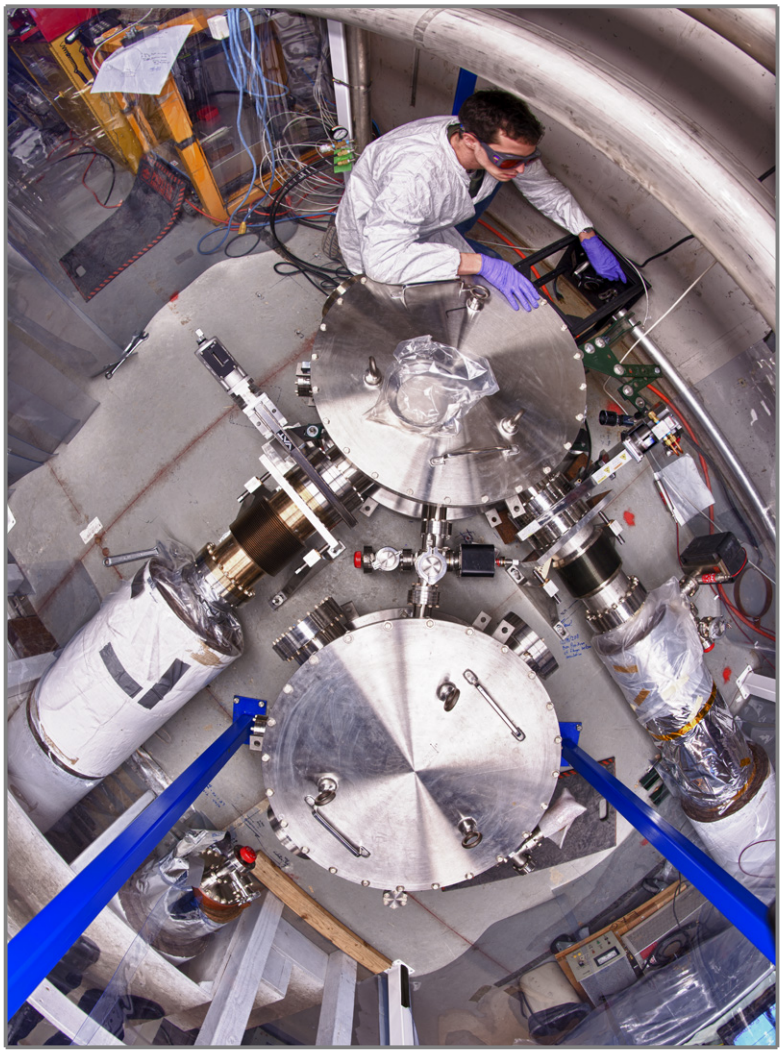
<u>Mitigation efforts underway:</u>

1. Mechanical iris to block halo
2. Optical fiber-based output mode cleaner
3. Replacement of suspect optics



Output beam profile.

Holometer Commissioning Status



The central vacuum service vessels housing the beamsplitters and power recycling mirrors.

Complete

- ✔ Infrastructure/vacuum system
- ✔ Final optics installed
- ✔ Interferometer control systems demonstrated
- ✔ Data acquisition system operating at design sensitivity
- ✔ **Full power build-up (1 kW)**

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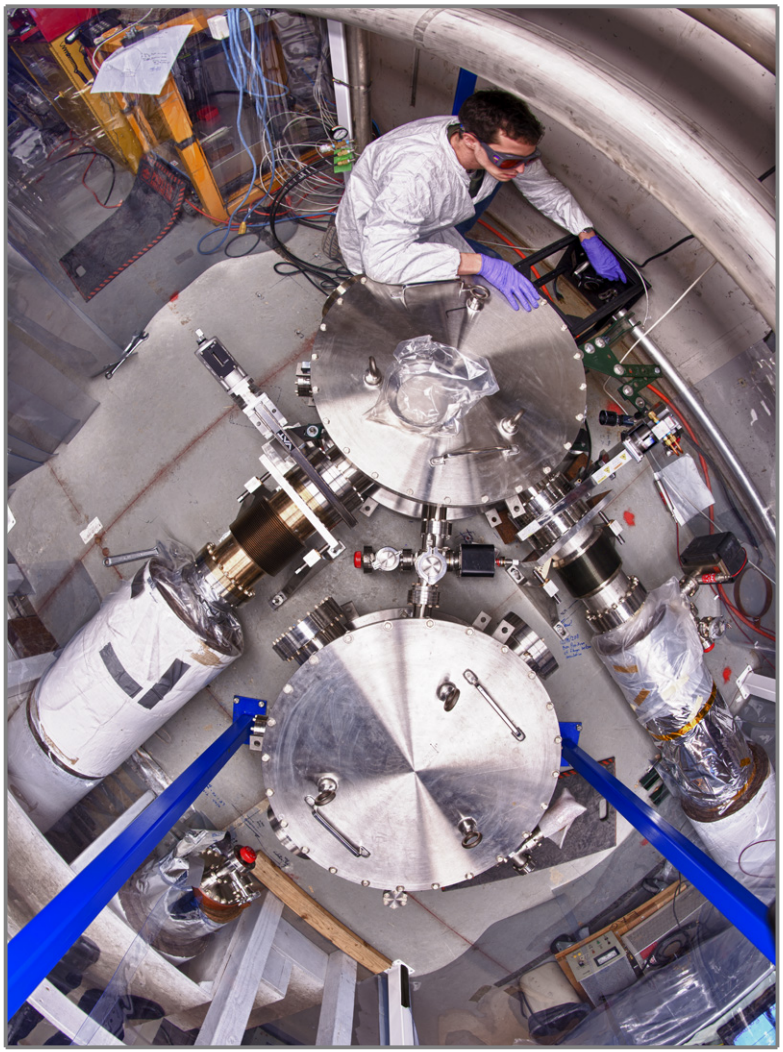

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Ongoing

- Mitigating constrast defect
- Automating lock acquisition
- Improving lock stability
- Suppressing RF cross-talk